

Response to DHEC August 12, 2008 Inquiry: Question #7

DHEC Question:

7) Please provide a comparison of emissions based on any data that you have or are aware of between pulverized coal and circulating fluidized bed, to include criteria pollutants and HAPS, on both a controlled and uncontrolled basis.

Response:

[The following response addresses only the issue of mercury emissions.]

Part of the activity by the mercury Working Group identified in response to Question #6, was to review EPA's ICR-3 stack test data for mercury emissions. The "Ranking Workgroup" produced a paper on December 18, 2001 (attached) which sorted and ranked the available emission data on several bases. The units reviewed included 6 FBC units: two burning waste bituminous coal, one burning a combination of bituminous coal and petroleum coke (B/PET), one burning subbituminous coal, and two burning lignite.

The most informative ranking approach is the last in the paper, which sorted the tests by fuel type, and then by lowest emissions. Note that for bituminous coals, the only FBC unit ranked fourth in lowest emissions. However, if waste-bituminous coals had been grouped with virgin bituminous coals, FBC units would have ranked #1, #2, and #6. Indeed, the waste-bituminous coal units had rates less than 10% of the emission rate of any other unit tested (using any coal). For subbituminous coals, a FBC unit was the lowest in the group, even though its only control system was an ESP. For all lignites, a FBC unit was lowest in emissions. For Texas lignites, which have much higher mercury content than ND lignites, the FBC unit had the lowest emissions.

These data support the views of most of the Working Group members that FBC systems are fundamentally different than pulverized coal systems, and that these differences are reflected in inherently lower mercury emissions.

Attachment

Presentation to Utility MACT Stakeholder Group December 18, 2001

By Ranking Workgroup:

Felice Stadler
Pat Rahe
Praveen Amar

Using the spreadsheet provided by the U.S. EPA, we were asked to rank the stack test data, and anticipate some of the questions that may be raised during this process.

The workgroup agreed that the first step was to rank the coal-fired boilers using, what we referred to as, “value neutral” criteria. In other words, we did not rank by boiler type, fuel type, or stack controls.

Our goal was to rank boilers based on their performance, which we defined in terms of the rate of mercury emitted from the stack. We intended to rank the boilers in two ways: 1. lbs/TBtu (F factor); 2. lbs/MWh. With the data supplied by EPA we were able to do the first part; additional data will need to be compiled (specifically the heat rate of each boiler) in order to calculate an output-based emission rate.

Ranking the data by just looking at what comes out of the stack allowed us to gain a better understanding of the operations of the top performing fleet (boiler type, fuel type, existing controls).

Below is a profile of the top ten plants (those with the lowest lbs/TBtu emission rate. (Refer to Maxwell’s definitions for explanation of abbreviations.)

Top 10 (lbs/TBtu from 0.0816-0.3348):

Boiler type:

3 FBC
1 Stoker
6 PC

Fuel type (during test):

2 waste bit.
1 bit./pet coke
7 bit.

PM controls:

9 baghouses
1 ESP-CS

NOx controls:

4 NOx combustion (see Maxwell’s definitions)
2 SNCR

- 2 SCR
- 2 no controls

SO₂ controls:

- 3 FBC
- 4 SDA
- 2 compliant coal
- 1 wet scrubber

Attached are several tables ranking the stack test data by emission rate (lb/TBtu), and then emission rate grouped by boiler type and fuel type. This was done to help illustrate that variation exists—in some cases it is significant.

The bottom line is that the performance of an individual boiler depends on a combination of factors, including things like boiler efficiency, which need to be considered collectively.

A necessary next step is calculating an output-based emission rate to ensure that this option is on the table. This is the only method that guarantees the inclusion of boiler efficiency as one of the methods for achieving higher performance (i.e., a lower emission rate).

Ranked by lb/TBtu

Plant name	Unit name	Boiler Type	PM control	FG D	Fuel in test	F factor lb/TBtu out control
Kline Township Cogen Facility	GEN1	FBC	BAGHOUSE		WASTE B	0.0816
Scrubgrass Generating Company L.P.	GEN1	FBC	BAGHOUSE		WASTE B	0.0936
Mecklenburg Cogeneration Facility	GEN 1	PC	BAGHOUSE		B	0.1062
Dwayne Collier Battle Cogeneration Facility	2B	STOKER	BAGHOUSE		B	0.1074
Valmont	5	PC	BAGHOUSE		B	0.1268
Stockton Cogen Company	GEN1	FBC	BAGHOUSE		B/PET	0.1316
SEI - Birchwood Power Facility	1	PC	BAGHOUSE		B	0.2379
Intermountain	2SGA	PC	BAGHOUSE	Y	B	0.2466
Logan Generating Plant	GEN 1	PC	BAGHOUSE		B	0.2801
Salem Harbor	3	PC	ESP-CS		B	0.3348
Clover Power Station	2	PC	BAGHOUSE	Y	B	0.3529
AES Hawaii, Inc.	A	FBC	BAGHOUSE		SB	0.4606
Clay Boswell	2	PC	BAGHOUSE		SB	0.6633
Craig	C3	PC	BAGHOUSE		SB	0.7248
W.H. Sammis	1	PC	BAGHOUSE		B	0.8291
Charles R. Lowman	2	PC	ESP-HS	Y	B	0.9706
Shawnee Fossil Plant	3	PC	BAGHOUSE		B/SB	1.0507
Cholla	3	PC	ESP-HS		SB	1.2066
Presque Isle	6	PC	ESP-CS		B/PET	1.2217
Presque Isle	5	PC	ESP-CS		B/PET	1.2622
Widows Creek Fossil Plant	6	PC	ESP-CS		B	1.3986
Craig	C1	PC	ESP-HS	Y	SB	1.4456
Big Bend	BB03	TURBO	ESP-CS	Y	B	1.5652
Valley	2	PC	BAGHOUSE		B/PET	1.6630
Meramec	4	PC	ESP-CS		SB/B	1.7255
AES Cayuga (NY) (formerly NYSEG Milliken)	2	PC	ESP-CS	Y	B	2.0652
R.D. Morrow, Sr. Generating Plant	2	PC	ESP-HS	Y	B	2.1269
Nelson Dewey	1	CYCLONE	ESP-HS		SB/PET	2.1349
Bailly	7	CYCLONE	ESP-CS	Y	B	2.2306
Coronado	U1B	PC	ESP-HS	Y	SB	2.4468
Comanche	2	PC	BAGHOUSE		SB	2.5931
Navajo	3	PC	ESP-HS	Y	B	2.7359
Jack Watson	4	PC	ESP-CS		B	2.9333
Laramie River Station	1	PC	ESP-CS	Y	SB	3.0184
Cholla	2	PC	MECH/PARTSCRUB	Y	SB	3.1864
Brayton Point	1	PC	ESP-CS		B	3.2000
Laramie River Station	3	PC	ESP-CS		SB	3.3411
Bay Front Plant	5	CYCLONE	MECH		B	3.5792
Brayton Point	3	PC	ESP-CS		B	3.6979
St. Clair Power Plant	4	PC	ESP-CS		SB/B	3.9076
R.M. Heskett Station	B2	FBC	ESP-CS		L	3.9768
Antelope Valley Station	B1	PC	BAGHOUSE		L	4.0042
Leland Olds Station	2	CYCLONE	ESP-CS		L	4.0233
Clay Boswell	3	PC	PARTSCRUB	Y	SB	4.0454
San Juan	2	PC	ESP-HS	Y	SB	4.2854
Cliffside	1	PC	ESP-HS		B	4.3223

Clay Boswell	4	PC	PARTSCRUB	Y	SB	4.4550
Jim Bridger	BW 74	PC	ESP-CS	Y	SB	4.7040
Presque Isle	9	PC	ESP-HS		SB	5.0738
Lawrence	4	PC	PARTSCRUB	Y	SB	5.1181
Wabash River Generating Station	1 + 1A	COAL GAS	NONE		B	5.3343
Polk Power	1	COAL GAS	NONE		B	5.4713
La Cygne	1	CYCLONE	PARTSCRUB	Y	SB	5.5140
Colstrip	3	PC	PARTSCRUB	Y	SB	5.7264
Montrose	1	PC	ESP-CS		SB	5.8573
Gaston	1	PC	ESP-HS		B	6.0738
Stanton Station	10	PC	BAGHOUSE		L	6.2517
Port Washington	4	PC	ESP-CS		B	6.6916
Dunkirk	2	PC	ESP-HS		B	6.8030
Clifty Creek	6	PC	ESP-HS		SB/B	6.8745
Stanton Station	1	PC	ESP-CS		L	6.9024
Newton	2	PC	ESP-CS		SB	6.9877
Wyodak	BW 91	PC	ESP-CS		SB	7.0701
Bruce Mansfield	1	PC	PARTSCRUB		B	7.0985
Sherburne County Generating Plant	#3	PC	BAGHOUSE		SB	7.5401
George Neal South	4	PC	ESP-CS		SB	7.7269
Rawhide	101	PC	BAGHOUSE		SB	7.7630
Coyote	1	CYCLONE	BAGHOUSE		L	7.9523
Sam Seymour	3	PC	ESP-CS	Y	SB	8.6353
GRDA	2	PC	ESP-CS		SB/B	8.6918
Gibson Generating Station (1099)	3	PC	ESP-CS		B	9.7452
Columbia	1	PC	ESP-HS		SB	10.3097
Platte	1	PC	ESP-HS		SB	10.6121
Lewis & Clark	B1	PC	PARTSCRUB		L	10.8315
TNP-One	U2	FBC	BAGHOUSE		L	10.8596
Limestone	LIM1	PC	ESP-CS	Y	L	13.6612
Monticello	3	PC	ESP-CS	Y	L	18.3232
Gibson Generating Station (0300)	3	PC	ESP-CS		B	29.0614
Big Brown	1	PC	ESP- CS/BAGHOUSE		L	30.0889
Monticello	1	PC	ESP- CS/BAGHOUSE		L	55.8686

Ranked by lb/TBtu and boiler type

Plant name	Unit name	Boiler Type	PM control	FG D	Fuel in test	F factor lb/TBtu out control
Nelson Dewey	1	CYCLONE	ESP-HS		SB/PET	2.1349
Bailly	7	CYCLONE	ESP-CS	Y	B	2.2306
Bay Front Plant	5	CYCLONE	MECH		B	3.5792
Leland Olds Station	2	CYCLONE	ESP-CS		L	4.0233
La Cygne	1	CYCLONE	PARTSCRUB	Y	SB	5.5140
Coyote	1	CYCLONE	BAGHOUSE		L	7.9523
Kline Township Cogen Facility	GEN1	FBC	BAGHOUSE		WASTE B	0.0816
Scrubgrass Generating Company L.P.	GEN1	FBC	BAGHOUSE		WASTE B	0.0936
Stockton Cogen Company	GEN1	FBC	BAGHOUSE		B/PET	0.1316
AES Hawaii, Inc.	A	FBC	BAGHOUSE		SB	0.4606
R.M. Heskett Station	B2	FBC	ESP-CS		L	3.9768
TNP-One	U2	FBC	BAGHOUSE		L	10.8596
Mecklenburg Cogeneration Facility	GEN 1	PC	BAGHOUSE		B	0.1062
Valmont	5	PC	BAGHOUSE		B	0.1268
SEI - Birchwood Power Facility	1	PC	BAGHOUSE		B	0.2379
Intermountain	2SGA	PC	BAGHOUSE	Y	B	0.2466
Logan Generating Plant	GEN 1	PC	BAGHOUSE		B	0.2801
Salem Harbor	3	PC	ESP-CS		B	0.3348
Clover Power Station	2	PC	BAGHOUSE	Y	B	0.3529
Clay Boswell	2	PC	BAGHOUSE		SB	0.6633
Craig	C3	PC	BAGHOUSE		SB	0.7248
W.H. Sammis	1	PC	BAGHOUSE		B	0.8291
Charles R. Lowman	2	PC	ESP-HS	Y	B	0.9706
Shawnee Fossil Plant	3	PC	BAGHOUSE		B/SB	1.0507
Cholla	3	PC	ESP-HS		SB	1.2066
Presque Isle	6	PC	ESP-CS		B/PET	1.2217
Presque Isle	5	PC	ESP-CS		B/PET	1.2622
Widows Creek Fossil Plant	6	PC	ESP-CS		B	1.3986
Craig	C1	PC	ESP-HS	Y	SB	1.4456
Valley	2	PC	BAGHOUSE		B/PET	1.6630
Meramec	4	PC	ESP-CS		SB/B	1.7255
AES Cayuga (NY) (formerly NYSEG Milliken)	2	PC	ESP-CS	Y	B	2.0652
R.D. Morrow, Sr. Generating Plant	2	PC	ESP-HS	Y	B	2.1269
Coronado	U1B	PC	ESP-HS	Y	SB	2.4468
Comanche	2	PC	BAGHOUSE		SB	2.5931
Navajo	3	PC	ESP-HS	Y	B	2.7359
Jack Watson	4	PC	ESP-CS		B	2.9333
Laramie River Station	1	PC	ESP-CS	Y	SB	3.0184
Cholla	2	PC	MECH/PARTSCRUB	Y	SB	3.1864
			B			
Brayton Point	1	PC	ESP-CS		B	3.2000
Laramie River Station	3	PC	ESP-CS		SB	3.3411
Brayton Point	3	PC	ESP-CS		B	3.6979
St. Clair Power Plant	4	PC	ESP-CS		SB/B	3.9076
Antelope Valley Station	B1	PC	BAGHOUSE		L	4.0042
Clay Boswell	3	PC	PARTSCRUB	Y	SB	4.0454
San Juan	2	PC	ESP-HS	Y	SB	4.2854
Cliffside	1	PC	ESP-HS		B	4.3223

Clay Boswell	4	PC	PARTSCRUB	Y	SB	4.4550
Jim Bridger	BW 74	PC	ESP-CS	Y	SB	4.7040
Presque Isle	9	PC	ESP-HS		SB	5.0738
Lawrence	4	PC	PARTSCRUB	Y	SB	5.1181
Colstrip	3	PC	PARTSCRUB	Y	SB	5.7264
Montrose	1	PC	ESP-CS		SB	5.8573
Gaston	1	PC	ESP-HS		B	6.0738
Stanton Station	10	PC	BAGHOUSE		L	6.2517
Port Washington	4	PC	ESP-CS		B	6.6916
Dunkirk	2	PC	ESP-HS		B	6.8030
Clifty Creek	6	PC	ESP-HS		SB/B	6.8745
Stanton Station	1	PC	ESP-CS		L	6.9024
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Columbia	1	PC	ESP-HS		SB	10.3097
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Lewis & Clark	B1	PC	PARTSCRUB		L	10.8315
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Monticello	3	PC	ESP-CS	Y	L	18.3232
Gibson Generating Station (0300)	3	PC	ESP-CS		B	29.0614
Big Brown	1	PC	ESP- CS/BAGHOUSE		L	30.0889
Monticello	1	PC	ESP- CS/BAGHOUSE		L	55.8686
Dwayne Collier Battle Cogeneration Facility	2B	STOKER	BAGHOUSE		B	0.1074
Big Bend	BB03	TURBO	ESP-CS	Y	B	1.5652
Wabash River Generating Station	1 + 1A	COAL GAS	NONE		B	5.3343
Polk Power	1	COAL GAS	NONE		B	5.4713

Ranked by lb/TBtu and fuel type

Plant name	Unit name	Fuel in test	Boiler Type	PM control	FG D	F factor lb/TBtu out control
Mecklenburg Cogeneration Facility	GEN 1	B	PC	BAGHOUSE		0.1062
Dwayne Collier Battle Cogeneration Facility	2B	B	STOKER	BAGHOUSE		0.1074
Valmont	5	B	PC	BAGHOUSE		0.1268
Stockton Cogen Company	GEN1	B/PET	FBC	BAGHOUSE		0.1316
SEI - Birchwood Power Facility	1	B	PC	BAGHOUSE		0.2379
Intermountain	2SGA	B	PC	BAGHOUSE	Y	0.2466
Logan Generating Plant	GEN 1	B	PC	BAGHOUSE		0.2801
Salem Harbor	3	B	PC	ESP-CS		0.3348
Clover Power Station	2	B	PC	BAGHOUSE	Y	0.3529
W.H. Sammis	1	B	PC	BAGHOUSE		0.8291
Charles R. Lowman	2	B	PC	ESP-HS	Y	0.9706
Shawnee Fossil Plant	3	B/SB	PC	BAGHOUSE		1.0507
Presque Isle	6	B/PET	PC	ESP-CS		1.2217
Presque Isle	5	B/PET	PC	ESP-CS		1.2622
Widows Creek Fossil Plant	6	B	PC	ESP-CS		1.3986
Big Bend	BB03	B	TURBO	ESP-CS	Y	1.5652
Valley	2	B/PET	PC	BAGHOUSE		1.6630
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Navajo	3	B	PC	ESP-HS	Y	2.7359
Jack Watson	4	B	PC	ESP-CS		2.9333
Brayton Point	1	B	PC	ESP-CS		3.2000
Bay Front Plant	5	B	CYCLONE	MECH		3.5792
Brayton Point	3	B	PC	ESP-CS		3.6979
Cliffside	1	B	PC	ESP-HS		4.3223
Wabash River Generating Station	1 + 1A	B	COAL GAS	NONE		5.3343
Polk Power	1	B	COAL GAS	NONE		5.4713
Gaston	1	B	PC	ESP-HS		6.0738
Port Washington	4	B	PC	ESP-CS		6.6916
Dunkirk	2	B	PC	ESP-HS		6.8030
Bruce Mansfield	1	B	PC	PARTSCRUB		7.0985
Gibson Generating Station (1099)	3	B	PC	ESP-CS		9.7452
Gibson Generating Station (0300)	3	B	PC	ESP-CS		29.0614
R.M. Heskett Station	B2	L	FBC	ESP-CS		3.9768
Antelope Valley Station	B1	L	PC	BAGHOUSE		4.0042
Leland Olds Station	2	L	CYCLONE	ESP-CS		4.0233
Stanton Station	10	L	PC	BAGHOUSE		6.2517
Stanton Station	1	L	PC	ESP-CS		6.9024
Coyote	1	L	CYCLONE	BAGHOUSE		7.9523
Lewis & Clark	B1	L	PC	PARTSCRUB		10.8315
TNP-One	U2	L	FBC	BAGHOUSE		10.8596
Limestone	LIM1	L	PC	ESP-CS	Y	13.6612
Monticello	3	L	PC	ESP-CS	Y	18.3232
Big Brown	1	L	PC	ESP- CS/BAGHOUSE		30.0889
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CS/BAGHOUSE					
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Coronado	U1B	SB	PC	ESP-HS	Y 2.4468
Comanche	2	SB	PC	BAGHOUSE	2.5931
Laramie River Station	1	SB	PC	ESP-CS	Y 3.0184
Cholla	2	SB	PC	MECH/PARTSCRUB	Y 3.1864
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St. Clair Power Plant	4	SB/B	PC	ESP-CS	3.9076
Clay Boswell	3	SB	PC	PARTSCRUB	Y 4.0454
San Juan	2	SB	PC	ESP-HS	Y 4.2854
Clay Boswell	4	SB	PC	PARTSCRUB	Y 4.4550
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Colstrip	3	SB	PC	PARTSCRUB	Y 5.7264
Montrose	1	SB	PC	ESP-CS	5.8573
Clifty Creek	6	SB/B	PC	ESP-HS	6.8745
Newton	2	SB	PC	ESP-CS	6.9877
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Rawhide	101	SB	PC	BAGHOUSE	7.7630
Sam Seymour	3	SB	PC	ESP-CS	Y 8.6353
GRDA	2	SB/B	PC	ESP-CS	8.6918
Columbia	1	SB	PC	ESP-HS	10.3097
Platte	1	SB	PC	ESP-HS	10.6121
Kline Township Cogen Facility	GEN1	WASTE B	FBC	BAGHOUSE	0.0816
Scrubgrass Generating Company L.P.	GEN1	WASTE B	FBC	BAGHOUSE	0.0936